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GEOGRAPHIC SUPPORT PROJECT

LEVEES IN THE RED RIVER DELTA



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CENTRAL INTELLIGENCE AGENCY
Office of Basic Intelligence

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LEVEES IN THE RED RIVER DELTA

A Preliminary Consideration
of the Feasibility and Effects of Breaching Levees
in the Ha Dong Area

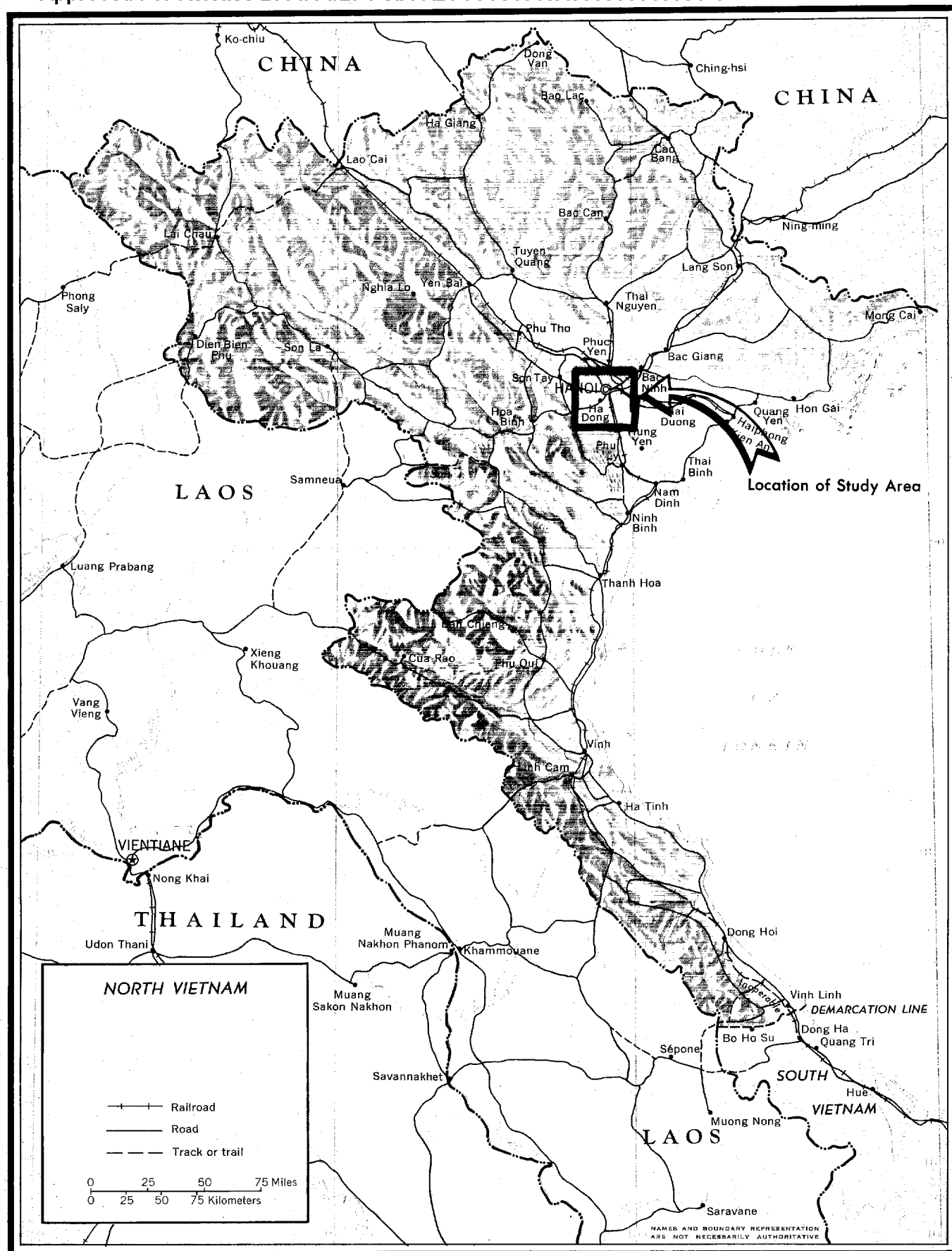
This study describes pertinent features of the Red River and the Red River Delta of North Vietnam. Selected past instances of natural breaching of the levees along the river are included. The Ha Dong area west and south of Hanoi (see Figure 1), which has been particularly vulnerable to flooding in the past, is studied in some detail and the feasibility of breaching its protective levees is considered.

I. Characteristics of the Red River Delta

The delta is a flat plain, crisscrossed by natural distributaries and manmade drainage and irrigation canals that are interwoven in a vast mosaic of ricefields. Viet Tri, at the head of the delta 100 miles inland, is only 43 feet above sea level; and the average, almost imperceptible, slope of the delta is less than 6 inches per mile.

In this flat environment it was essential that levees be built to protect the land from flooding by the rivers that cross it. By constricting the greatly expanded volume of floodwaters, however, the levees accentuate the threat created when the river level is above the level of the surrounding land. The Red River has flowed as much as 26 feet above the land in the Hanoi area, a situation that suggests the magnitude of the flooding that would occur should the levees be breached.

The delta is compartmented by the natural and manmade levees of the different distributaries. (The French use the descriptive term "casier," that is, "pigeonhole," to refer to the compartments resulting from this process.) Streams originate on the sides of the highest levees and flow toward the lowest elevation in the compartment. It is extremely difficult to drain these compartments, particularly when the bordering rivers are in flood and may be flowing above the elevation of the land in the compartment.



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II. The Red River

The Red River, some 750 miles in length, rises in southern China. At the China - North Vietnam border, 320 miles from the sea, it is only 293 feet above sea level. Thus, its average fall is less than a foot a mile, a factor which strongly influences its flood characteristics.

During the low-water period, October through May, the Red River at Hanoi may be only 200 to 400 yards wide, though it flows through a sandy riverbed 1 to 2 miles wide. Figures for the level of the river at Hanoi near the beginning of the low-water period, 1 November for the years 1958 through 1962, indicate an average of 16 feet above sea level. Its average level at Hanoi in the later stages of the low-water period, however, is about 8 feet above sea level.

The river starts to rise at the beginning of June and subsequently fills its wide bed until at high-water the river level at Hanoi is usually at least 26 feet above sea level. Figure 2 shows the variation in river level from May through November over a 28-year period, indicating that the average is well over 26 feet in July, August, and September. Figure 3 shows the mean discharge at Son Tay, about 25 miles upriver from Hanoi. In the 1915 flood, the discharge at Son Tay was measured at about 1 million cubic feet per second. (By comparison, when the British Royal Air Force breached the Moehne and Eder dams in Germany in 1943, the peak discharges were 310,000 and 300,000 cubic feet, respectively.)

The high-water period, however, is not made up of a single flood with equally gradual upsurge and downfall, but rather it includes several floods each of which may cause the river to rise far above the average summer water level (see Figure 4). As a result of the very gradual gradient of the river, these floods are relatively slow. Figure 5 shows that the river took 8 days to rise from 23 to 39 feet in the 1926 flood.

The highest floods are generally in July and August, although flooding in June and September is fairly common -- statistics indicate that between 1884 and 1923 there were 20 floods above 23 feet before 20 June and 59 floods above 23 feet after 1 September.

III. Past Breaks in the Red River Levees

Breaks in the levees have occurred frequently. Since 1900 the levees have been breached in 1902, 1903, 1905, 1909, 1911, 1913, 1915, 1917, 1918, 1923, 1924, and 1926.

One of the most disastrous floods occurred in 1915, when levees were breached in 48 places. The Ha Dong area was almost completely inundated -- 257,000 acres of the total area of 268,000 acres were flooded. In the

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TABLE II - 1
RIVER LEVELS AT HANOI
MEANING OF SYMBOLS

	0	above 26 feet					
	00	above 29.5 feet					
	000	above 33 feet					
YEAR	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	Nov.
1907				0		00	
1908		00	0	00	00	00	00
1909			00	000	000	0	
1910				000	00		
1911		00	000	000	0		
1912			0	000	0		
1913		0	000	000	0		0
1914			000	00	00		
1915	00		000	00	0		
1916		0	0	0	0	00	
1917			000	000	0		
1918	00	00	000	000	00	0	
1919		0	000	000	00		
1920	0		0	0	000		
1921		0	000	000	000	0	
1922		0	00	000	00		
1923		00	00	000	00		
1924		0	000	00	0		
1925			00	00			
1926		0	000	000	0	0	
1927		0	00	000	0	00	
1928		0	000	000	0		
1929		0	00	000	000	0	
1930		00	0	00	00		
1931	No data						
1932			000	000	000	000	
1933	No data						
1934			000	000	00		

Figure No. 2
(Reproduced From JANIS, 1945)

C-O-N-F-I-D-E-N-T-I-A-L

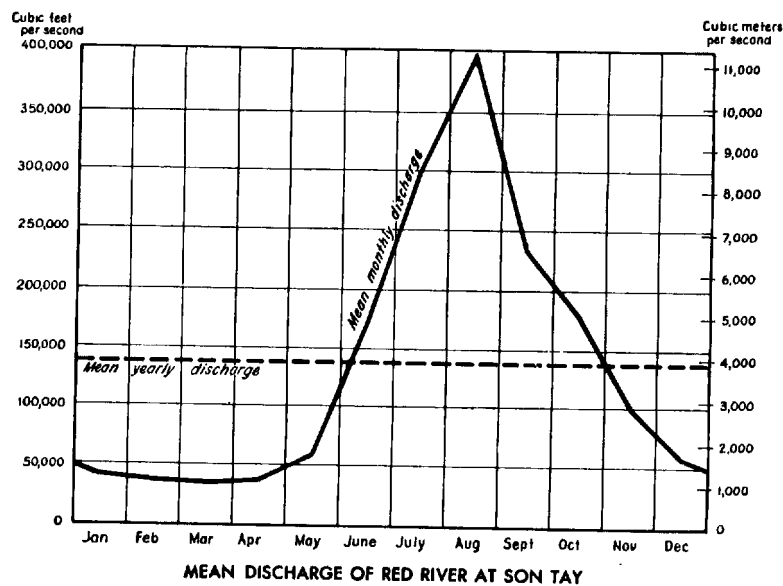
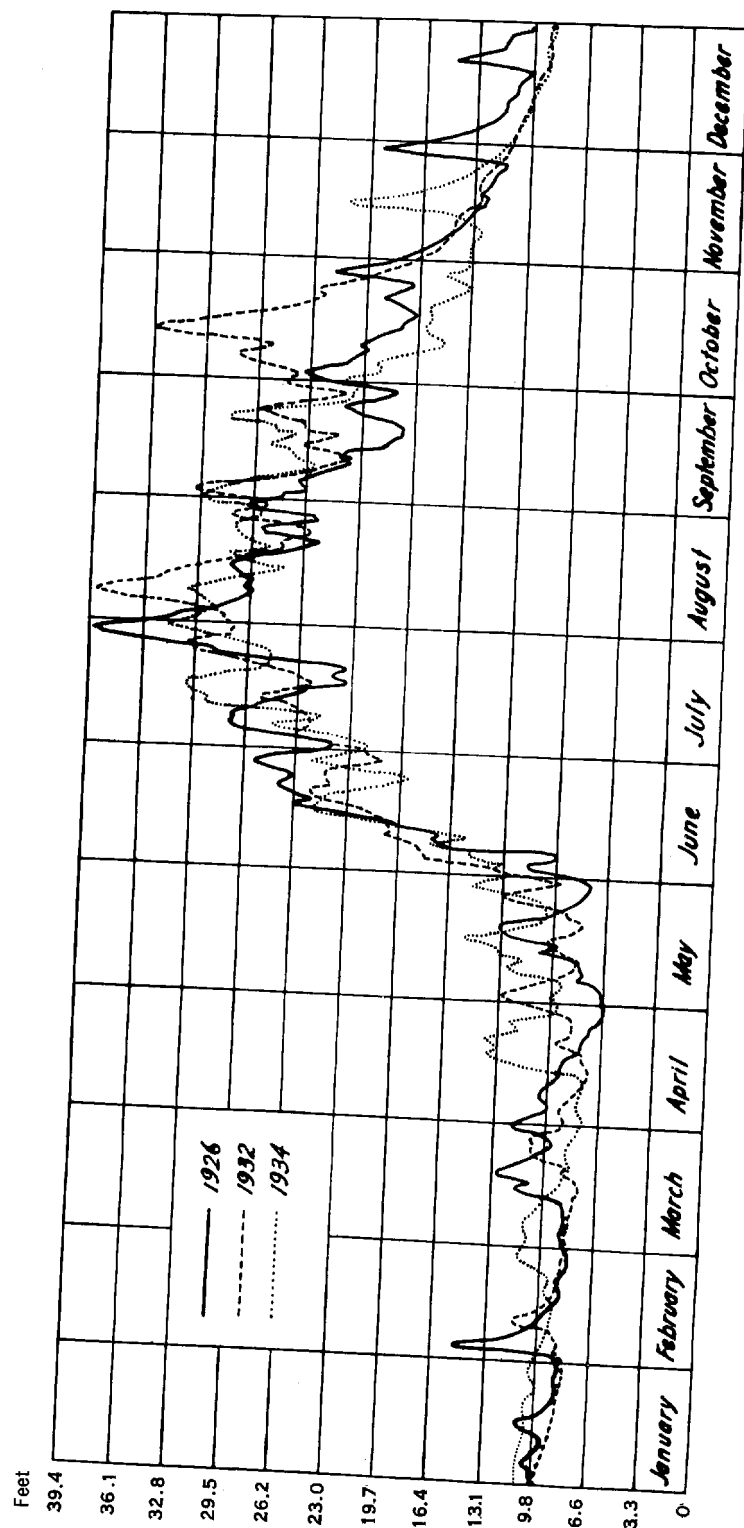


Figure No. 3
(Reproduced From JANIS, 1945)

C-O-N-F-I-D-E-N-T-I-A-L



LEVELS OF RED RIVER AT HANOI IN 1926, 1932, 1934

Figure No. 4
(Reproduced From JANIS, 1945)

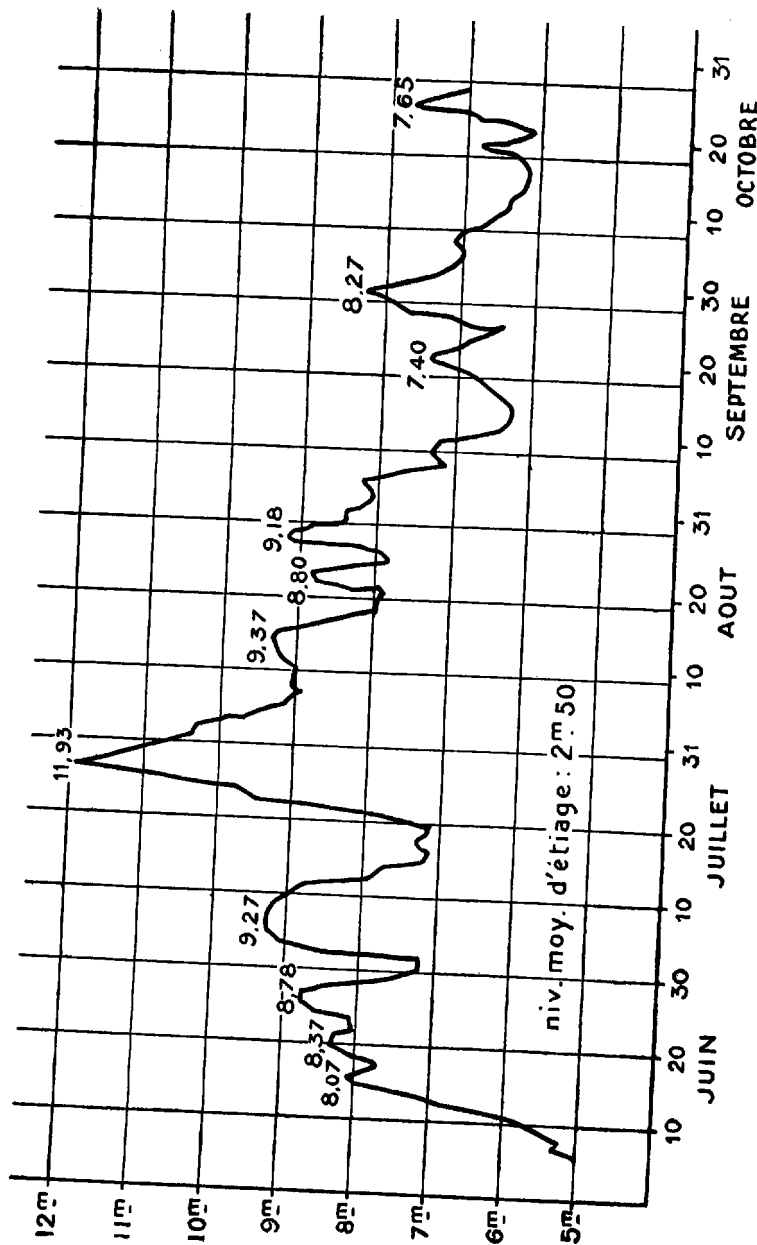


Figure 5

(Reproduced From Gourou, Le Tonkin)
 Water level of the Red River at Hanoi during the period June through October 1926. The level of 11.93 meters, about 39 feet, is the highest ever recorded at Hanoi. The greatest increase in volume came during an 8-day period in July.

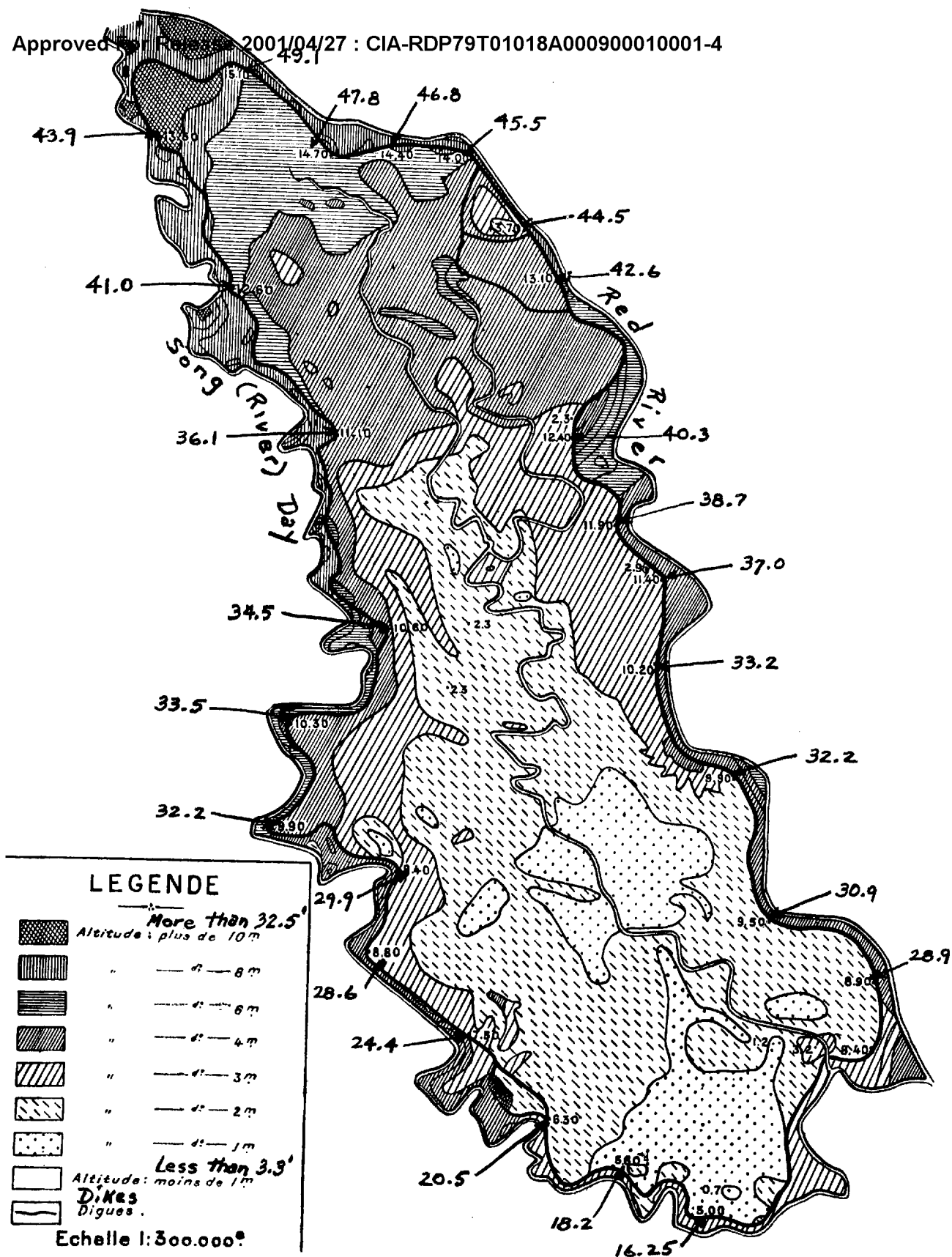
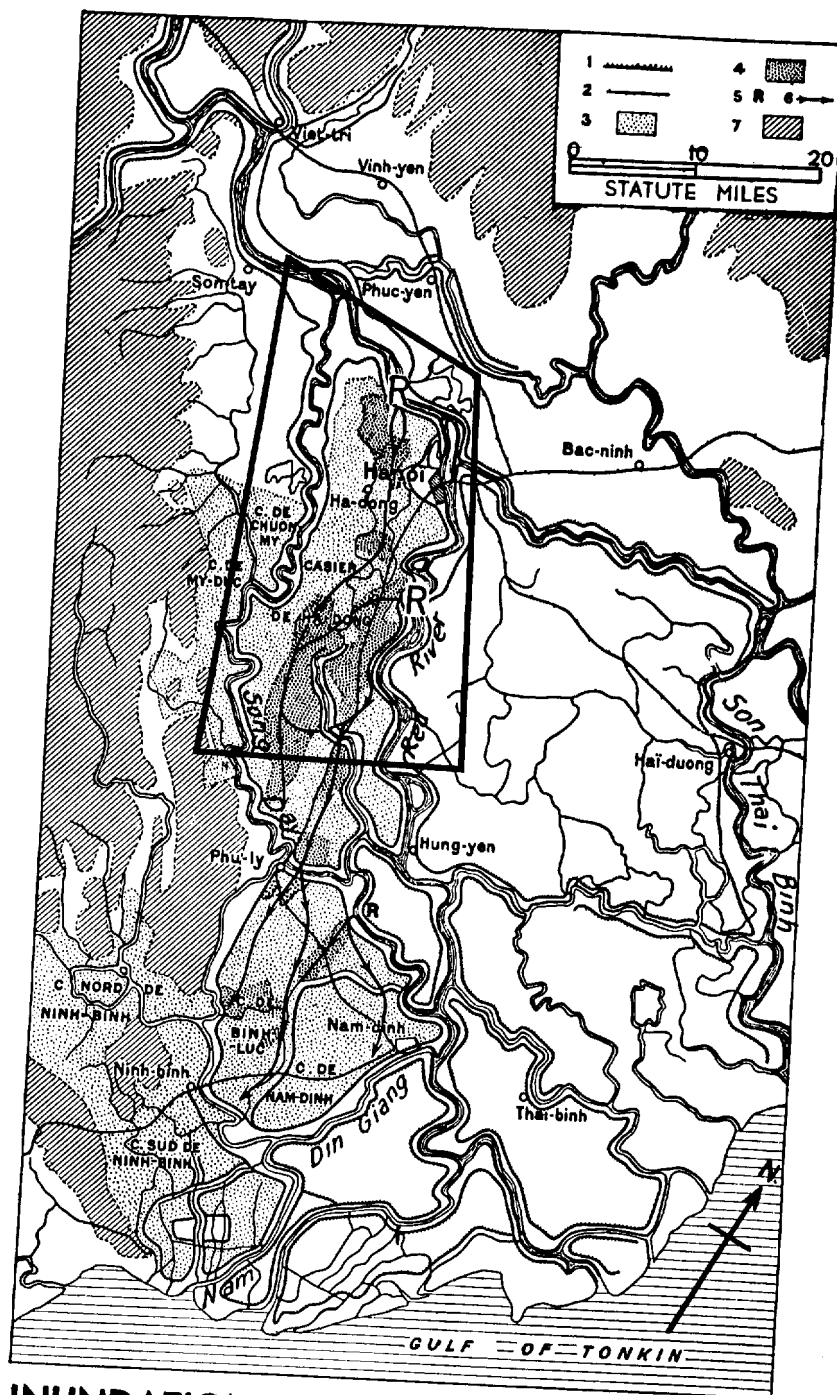


Figure 6

(Reproduced From Gourou, *Le Tonkin*)

Elevation of land in the area bordered by the Red River on the north and east and the Song (River) Day on the west. Elevations along the top of the levees are indicated in meters. This area is the French called Casier (compartment) de Ha Dong. It has always been susceptible to flooding; in the 1915 flood, water reached a level of about 19 feet in the southern sector.



INUNDATION OF TONKIN PLAIN IN 1915

1, Levees; 2, Railroads; 3, Inundated areas suffering little damage; 4, Areas of greatest damage; 5, Levee breaks (crevasses); 6, Currents in inundated areas; 7, Hills and mountains.

Figure 7
(Reproduced From JANIS, 1945)
The approximate location of the Study Area
is outlined

southern part of the Ha Dong area, water reached a level of 6 meters, or about 19 feet. Figures 6 and 7, roughly indicating the topography of the compartment, give some idea of the devastation caused by this depth over the ricefields. After the flood had receded, one section of the Ha Dong area was described as having "...the striking appearance of deserted dunes where, outside of half-ruined villages, nothing showed man's centuries-long work. Paths, streams, lowlands were all levelled, and all over this huge desolate expanse was not a blade of grass, not one tree, not a tombstone, no sign of life."

On 30 July 1926, three breaches occurred in the levees not far from Hanoi. Two were closed on the 8th and the 12th of August, but one remained open. Consequently, over 250,000 acres of land on the left bank of the Red River were flooded.

IV. Feasibility of Flooding the Ha Dong Area

The study area lies south and west of the Red River in the vicinity of Hanoi; of particular interest is the Ha Dong area which is compartmented by the levees of the Red River on the north and east and the levees of the Song (River) Day on the west. (See Figures 6 and 8.) The spot heights (elevations) on Figure 8, studied in conjunction with the heights of selected levees shown on the overlay, reveal that the area is essentially a corridor with a slight north-south slope. The terrain also slopes inward from the Red River levees on the east and from the Song Day levees on the west. In the north the land varies in elevation from 12 to almost 35 feet, but much of the area south of the town of Ha Dong is less than 7 feet above sea level. This low-lying land is often inundated by heavy precipitation, per se; as of 22 June 1965, some of it was already under water to the extent that rice seedlings for the autumn crop were endangered.

The overlay Selected Levees on Figure 8, based on aerial photography, shows that the major levees along the Red River and Song Day are from 22 to 40 feet in elevation.* In general, this interpretation agrees with the spot heights shown on Figure 6, although from the Hanoi area upriver the levees on the Red River are above 40 feet, mostly between about 42 and 49 feet (see Plate I). Similarly, some of the levees on the Song Day are above 40 feet in height. The area compartmented by these major levees is crisscrossed by secondary levees that vary from 4 to 22 feet in elevation. Spot heights of some of these secondary levees are shown on the overlay.

* The levees are shown in much greater detail on the annotated map mosaic at 1:50,000 scale, which together with aerial photos comprises the separate folder accompanying this study.

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Some conception of how many people would be affected if the area were flooded may be gained from the overlay Estimated Population by District on Figure 8. According to 1956-57 population estimates published in Hanoi in 1958, there are about 1,163,000 people in the Ha Dong area, including Hanoi.

The overlay Selected Installations on Figure 8 locates and identifies selected installations that would be affected to varying degrees by flooding in the area. They include the SAM sites, barracks, supply depots, radio stations, and industrial plants (see Plate II).

The area is traversed by Route No. 1A, the main road from Hanoi southward along the coast; the Hanoi - Thanh Hoa rail line; and Route No. 6, which leads to the Dien Bien Phu area. These transportation routes are on embankments 3 to 14 feet high, but even so they are occasionally flooded to a depth of 4 to 8 inches. Normally, however, traffic is not interrupted (see Plate II).

In the low-lying parts of the area only 5th-month rice (harvested in June) is grown, as excessive inundation of the land during the summer prevents planting of the 10th-month rice (harvested in October-November). Tenth-month rice is planted in the highest parts of the area; and both 5th-month and 10th-month rice are planted in the transitional area between the highest and lowest parts (see Figure 9 and Plate I). If rice is submerged for as much as 4 days, it generally is killed. If the Ha Dong area were flooded most of the rice crop would probably be destroyed.

The task of breaching the levees is influenced by three considerations:

1. The network of protective secondary levees estimated to be as high as 22 feet would probably localize and minimize flood damage. It is possible, however, that these secondary levees could not withstand a flood discharge flow such as that measured in the 1915 flood (see Section II, The Red River) and consequently might deteriorate.
2. To achieve the maximum effect, the breaching would have to be accomplished when the level of the Red River is close to the top of the main levees upriver from Hanoi. As can be seen from Figure 2, the river level is often above 33 feet during July, August, and September. The optimum time for achieving maximum effect would be after a typhoon -- when the river level rises above even the normal summer high water. As of 12 August 1965, the Red River had not covered the islands near Hanoi, which have peak elevations of about 33 feet.

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3. A fairly large air operation would have to be mounted to achieve breaching by air attack. On the basis of PACAF computations, to effect a breach in each of the two major levees at Hanoi would require the following bombs:

	Weight of Bomb		
	<u>3,000 lb</u>	<u>2,000 lb</u>	<u>1,000 lb</u>
Number required	390	500	1,120

Also according to PACAF, the breaching of secondary levees would significantly increase these requirements. In view of the past history of flooding in the Study Area, however, it is conceivable that breaching of only the main levees would accomplish significant flooding.

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Figure 9

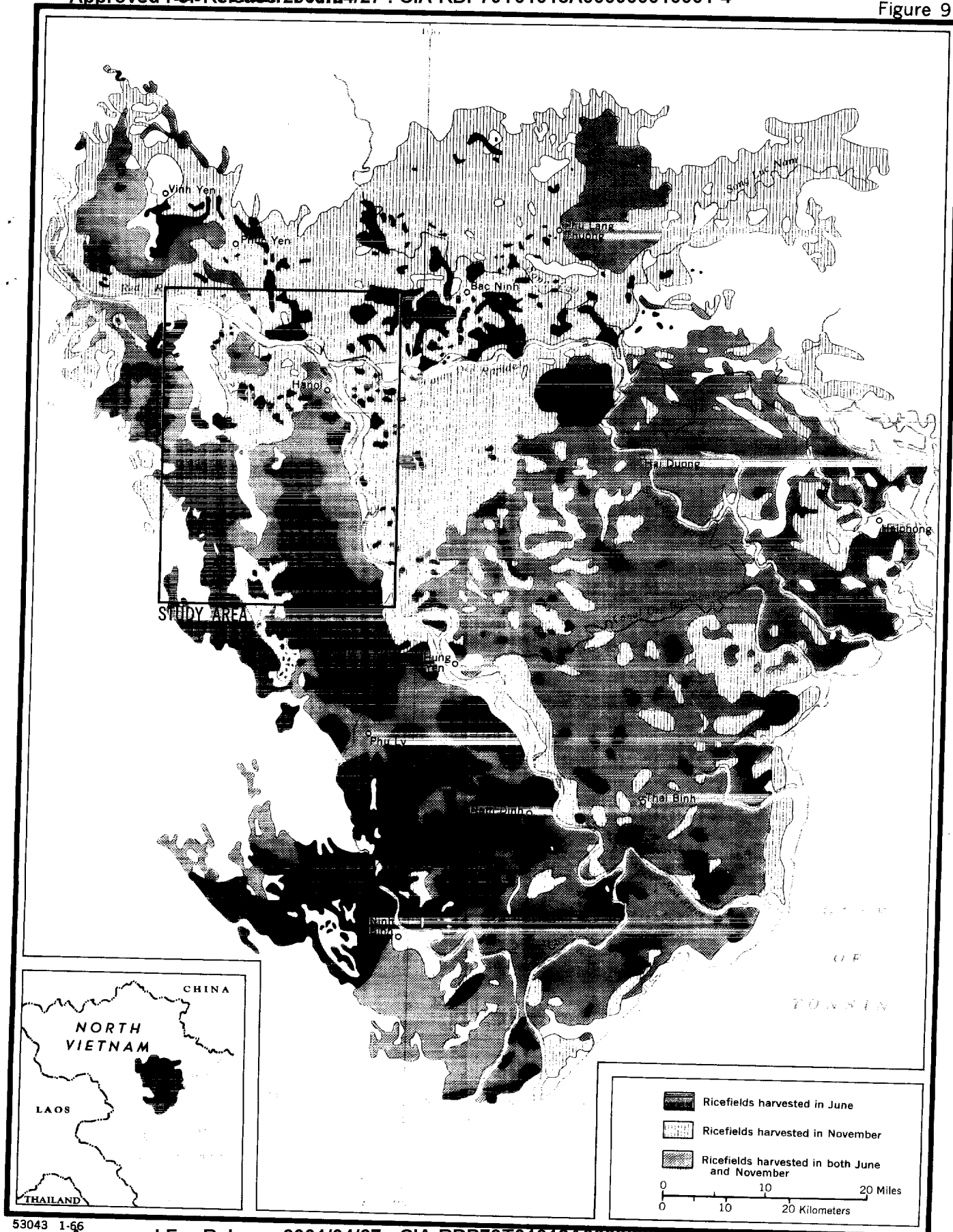


PLATE I



View northeastward from Hanoi across the Red River, showing the Doumer Bridge. The River is in high-water stage and covers part of the large island. The main levees in this area are more than 40 feet in height.

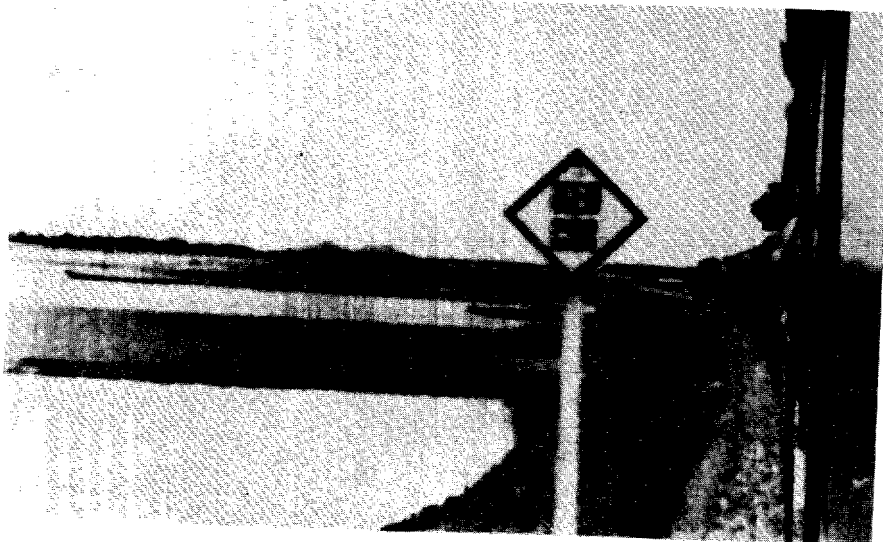


Rice fields (paddys) in the Hanoi area. Dikes 2 to 4 feet high edge the individual paddy fields.

PLATE II



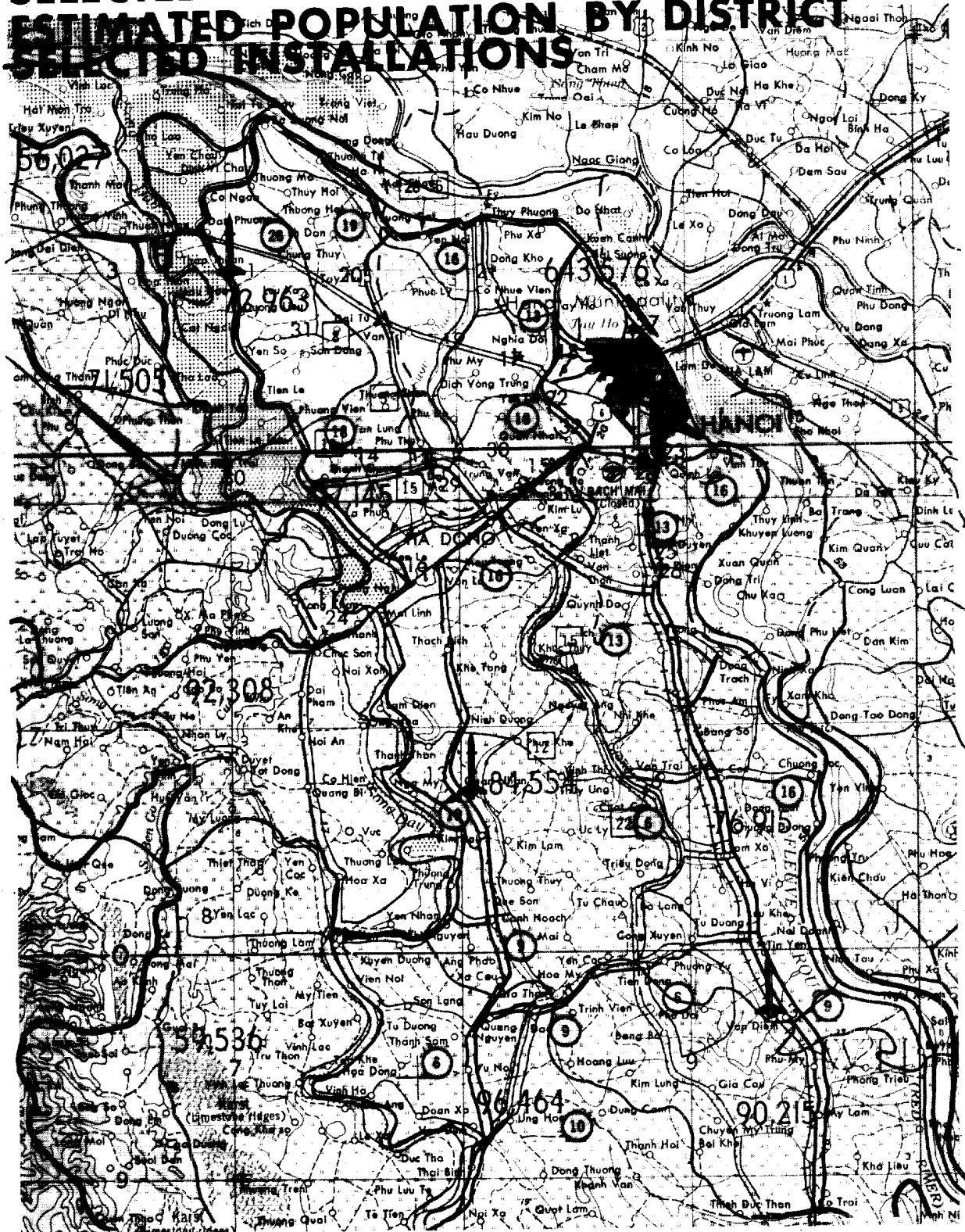
Hanoi Motor Vehicle and Machine Tool Plant, No. 33, on the overlay, Selected Installations. The security wall surrounding the plant might offer some protection against flood damage.



Rail line south of Hanoi. Rail embankments in the Delta are from 3 to 14 feet high.

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SELECTED LEVEES ESTIMATED POPULATION BY DISTRICT SELECTED INSTALLATIONS



- | | |
|-----------------------------------|-------------------------------|
| 13 Spot height in feet | — Province boundary |
| Major levee 22-40 feet | — District boundary |
| Secondary levee 4-22 feet | - - Hanoi municipality |
| 10 Height of levee in feet | - - Hanoi city |
| 24 Selected installations | 64,945 Population of district |

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FIGURE 8

SELECTED INSTALLATIONS IN STUDY AREA

Map Scale 1:250,000

<u>Map Number</u>	<u>Installation</u>
1	SAM Site A-29-2
2	SAM Site B-21-2
3	SAM Site B-17-2
4	Hanoi/Bac Mai Airfield Runway presently 4100', extendable to 5100'. Airfield complex includes hangars, barracks, storage/support buildings.
5	Hanoi Railroad Classification Yards and Shops Terminus for all rail lines in North Vietnam. Complex includes repair shops, support buildings, warehouses.
6	Phu Coc Army Barracks, West Capacity, 2000 men. 27 buildings.
7	Xuan Mai Army Barracks, South Southwest Site of special insurgency training center for large infiltration groups sent to support Viet Cong and Pathet Lao. Capacity 7000 men. 300 buildings.
8	Phu Yen Army Barracks, West Capacity 2000 men. 46 buildings.
9	Ha Dong Army Barracks, Northeast Capacity, 7000 men; possibly regimental headquarters. 266 buildings.
10	Xuan Mai Army Barracks Capacity, 1250 men. 56 buildings.
11	Chuc Son Army Barracks, North Capacity, 4000 men. 87 buildings.
12	Hanoi Army Barracks (Bac Mai Airfield) Capacity, 2000 men. 110 buildings.
13	Ninh Duong Army Barracks, Southwest Capacity, 1000 men. 65 buildings.
14	Dai Mo Army Barracks Capacity, 1600 men. 71 buildings.
15	Ha Dong Army Barracks Capacity, 3400 men. 84 buildings.

<u>Map Number</u>	<u>Installation</u>
16	Ha Dong Army Barracks, Southwest Capacity, 750 men. 58 Buildings.
17	Hanoi Army Barracks West, Mai Dich Capacity, 2500 men. 91 buildings.
18	Hanoi Army Barracks West, Tay Ho Capacity, 3000 men. 172 buildings.
19	Hanoi Army Barracks, West Northwest Capacity, 2000 men. 100 buildings.
20	Dan Hoi Army Barracks, South Capacity, 2450 men. 40 buildings.
21	Hanoi Army Barracks, North Northwest Capacity, 1500 men. 112 buildings.
22	Hanoi Army Barracks West Yen Lang Capacity, 9500 men. 198 buildings.
23	Hanoi Army Supply Depot, South Quinh Loi 232 buildings.
24	Mai Linh Army Supply Depot 122 buildings.
25	Van Dien Motor Vehicle Storage and Repair Shops 60 buildings.
26	Van Dien Army Supply Depot One of largest storage complexes in North Vietnam. Storage capacity, estimated 820,000 square feet. 291 buildings.
27	Hanoi Army Supply Depot, North Tay Ho Major supply and support element for Hanoi military complex. 340 buildings.
28	Hanoi Petroleum Products Storage, Bac Mai Second largest POL storage in Hanoi. Five tanks with capacity of 1,452,000 gallons.
29	Hanoi Radio Transmission Station, Dai Mo Principal point-to-point HF transmitting station in North Vietnam for domestic and international communications.
30	Hanoi Radio Broadcasting Station, Me Tri Contains transmitting facilities of Radio Hanoi; also main transmitting facilities of the North Vietnamese Army point-to-point radio network.
31	Hanoi International Radio and Receiving Station, Son Dong One of largest international radio receiving station in North Vietnam.

<u>Map Number</u>	<u>Installation</u>
32	Hanoi Rubber Products Plant Largest rubber plant in Hanoi; produces tires.
33	Hanoi Motor Vehicle and Machine Tool Plant Largest machine building plant in North Vietnam.
34	Hanoi Machinery Works, Tran Hung Dao One of two largest engineering plants in North Vietnam.

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